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1. GENERAL DESCRIPTION

1.1 SCOPE

This document specifies the Bulk Core Storage Unit (BCSU) Power System. The BCSU consists of one, two or four magnetics modules, core controller, operator panel, maintenance test panel (wired in or plug in), AC Power Panel #4, harnesses and regulators with interconnecting wiring. The Power System is primarily the regulators with interconnecting wiring. The other elements of the BCSU are considered as designed and specified separately. The input power, signal interfaces, output requirements, life, reliability and environmental conditions imposed on the BCSU power system comprise this specification.

1.2 APPLICABLE DOCUMENTS

AC Power Panel #4	43D232735
Schematic Diagram - AC Power Panel #4	43D233089
Control Panel	43C228273
Schematic Diagram - Control Panel	43D222301
General Design Requirements	43A177851

2. INPUT POWER

2.1 LINE VARIATIONS-OPERATING

The input power to the BCSU power system shall conform to EPS 43A177851, paragraph 4.0.

2.2 POWER OUTAGE

The BCSU power system shall operate, with all regulator output voltages remaining in confidence (see paragraph 4.3.1) with an a-c input transient defined as an output voltage reduction of 2.5 percent and a frequency reduction to 50 hertz lasting 20 seconds or less. This transient is imposed in addition to the 120 volt ± 5 percent line to neutral range defined in EPS 43A177851.

2.3 LINE BALANCE

The combined a-c steady state load presented by the BCSU shall be balanced within 10 percent or 1 ampere, whichever is greater. This requirement is imposed on the CSU power system as well.

2.4 POWER FACTOR

The BCSU power system shall present a steady state load to the motor-generator which has a power factor of 0.80 or greater.

3. INPUT AND OUTPUT CIRCUITS

3.1 POWER-ON/OFF INTERFACE INFORMATION

3.1.1 Input Circuit Breaker - Care Package

The power-on circuits can be activated if power is available to the BCSU and the a-c input circuit breaker is closed. When the a-c circuit breaker is closed the control panel "AC Breaker On" lamps light. Opening the a-c breaker will remove all power from the CSU.

3.1.2 Power-On Switch - Cabinet Operator Panel

Activation of the Power-On Switch will result in a-c 3-phase 5-wire power being available to the BCSU power system and fans.

3.1.3 Power-Off Switch - Cabinet Operator Panel

Activating this switch will remove a-c power from the BCSU power system and fans.

3.1.4 Remote Control To AC Power Panel #4 (Care Package)

Remote power-on and off control capability shall be provided and function like 3.1.2 and 3.1.3 above.

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3.2 REGULATED D-C OUTPUT SEQUENCING AND CONTROL

3.2.1 Low Voltage D-C Sequence (On)

The +5 volt supply for core controller shall be turned on first. The +5 volts to the magnetics module shall be available after the +5 volts above.

3.2.2 Low Voltage Confidence (Level 1 Confidence)

After all the low voltage supplies are available and within voltage limits a low voltage confidence signal shall be sent to the core controller. Confidence shall be indicated by a logic "0" and lack of confidence will be a logic "1."

3.2.3 High Voltage Enable

After the receipt of low voltage confidence the core controller shall provide a high voltage enable output to cause the high voltage regulators to be turned on. A logic "0" shall allow the regulators to turn on and a logic "1" or an open circuit shall turn them off.

3.2.4 High Voltage Confidence (Level 2 Confidence)

When the high voltage regulators are up to voltage and within voltage limits, a high voltage confidence line shall be sent to the core controller. Confidence is a logic "0" and lack of confidence shall be a logic "1."

3.2.5 Turn Off Sequence

The high voltage regulator outputs, per Section 4, shall conform to Figure 1. This represents the normal (nominal RC time constant) shutdown voltage delay when shutdown is initiated by the loss of phase detection circuit.

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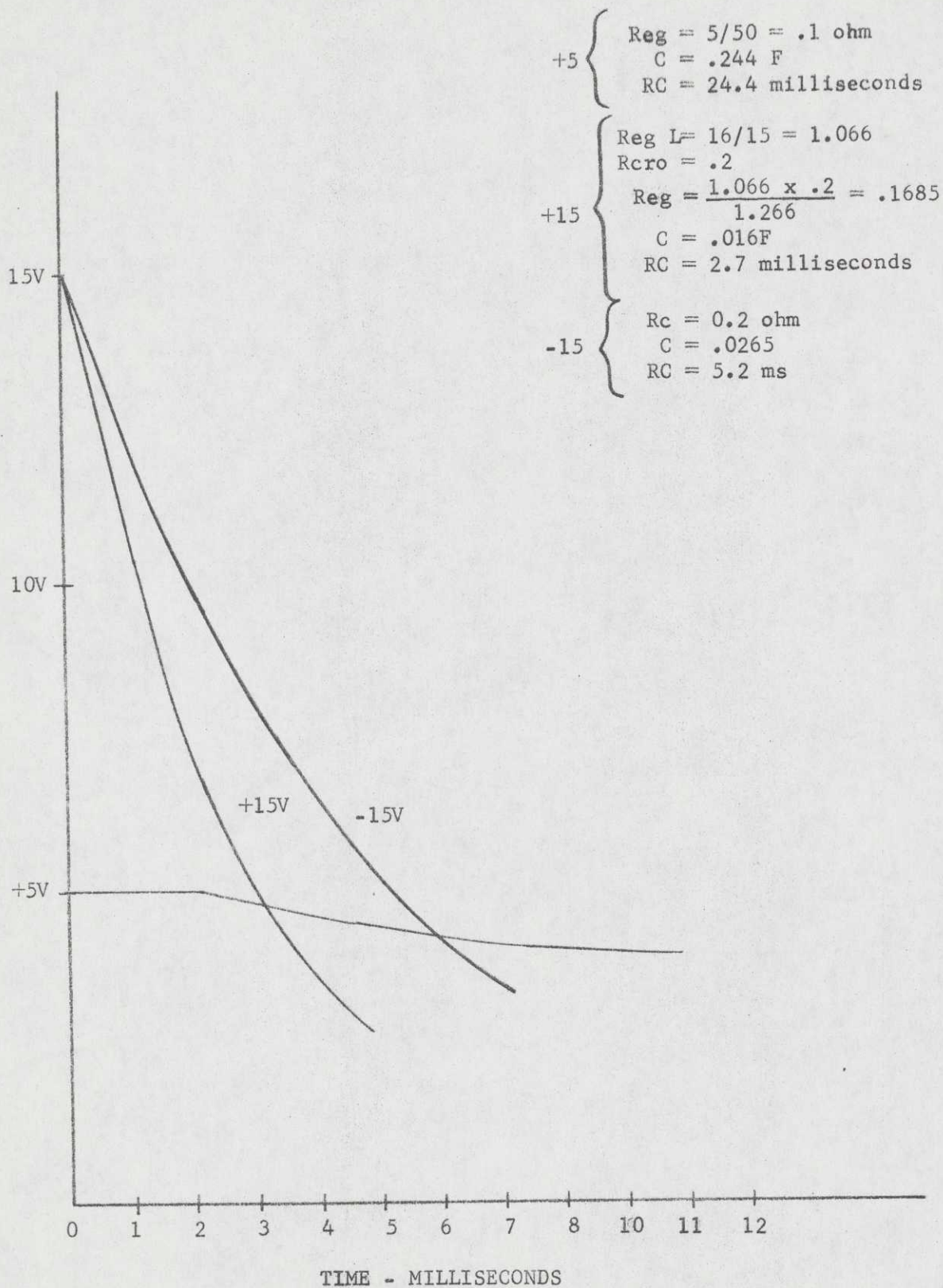


FIGURE 1

The following reasons will result in complete shutdown of all regulators. See 3.2.7 for additional details.

1. Removal or complete loss of input power (ac).
2. Temperature shutdown.
3. An out of confidence of any low voltage regulator.
4. Loss of any phase of input power.
5. Any regulator fault.

Removal of high voltage enable will cause the high voltage regulators to shutdown. The high voltage regulators shall have crowbar circuits to speed removal of voltages. The low voltage regulators may be left on during "decay rate" condition or means shall be provided for turning the low voltage regulators on with the high voltage regulators disabled.

The high voltages shall not start to crowbar down before 100 microseconds after indication of 1 through 4 above.

A voltage regulator failure may result in immediate shutdown without the 100 microsecond requirement.

3.2.6 Local Control and Status Indication

In addition to the automatic sequencing described above, each output shall be protected by means of appropriately rated circuit protective devices to protect against overcurrent and overvoltage. Operation of the circuit protective devices shall result in loss of confidence from the regulator.

Each regulator output shall be monitored and visual indication of regulator operation shall be provided. Either confidence or lack of confidence indication shall be provided.

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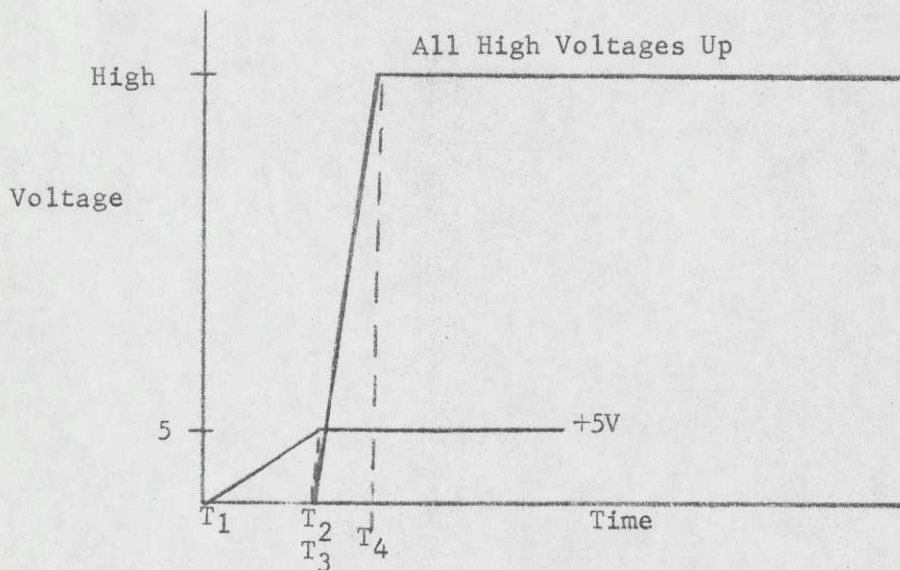
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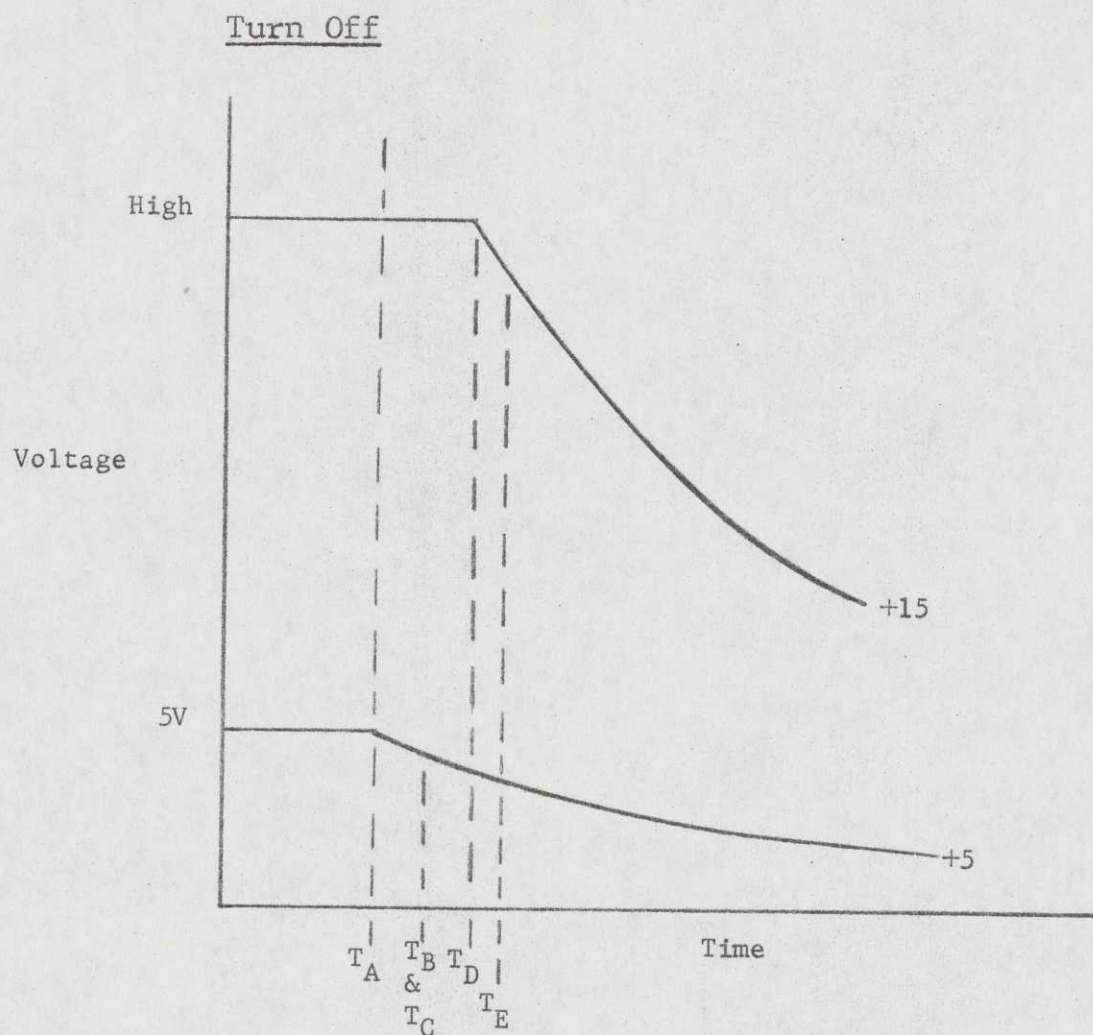
3.2.7 Power Turn On and Failure

In the event of a-c power turn on, power failure, or BCSU system turn off the supplies shall conform to the following:

Turn On

- T_1 = Power Turn On
- T_2 = +5 Volts Confident
- T_3 = High Voltage Enable
- T_4 = High Voltages Confident (not coincidently)
(Level 2 Confidence)





- T_A = Power Turn Off from a LV Regulator Fault Condition
- T_B = Loss of Level 1 Confidence
- T_C = Loss of High Voltage Enable
- T_D = High Voltage Crowbar Start
- T_E = Loss of Level 2 Confidence

Loss of Level 1 Confidence shall take place because the +5 volts regulator has reached its undervoltage point (-10 percent), or because of any Level 1 regulator fault condition.

Loss of Level 2 Confidence shall take place because the high voltage regulators have reached their undervoltage point (-10 percent), or because of any regulator fault condition.

3.3

TEMPERATURE ALARM

There shall be provision in the AC Power Panel #4 for accepting a normally open thermal alarm input from the power supply. This input shall be monitored at all times and when "normal" or "alarm" conditions exist shall provide outputs as follows:

	<u>Normal</u>	<u>Alarm</u>
To AC Power Panel #4	Open Contacts (isolated)	Closed Contacts

The AC Power Panel #4 circuit is isolated from frame ground.

The AC Power Panel #4 will provide for overtemperature contacts to light lights in the operator panel and for remote alarm indication.

An audible thermal alarm shall be provided on the AC Power Panel #4 and an alarm reset will be provided on the operator panel (and at a remote point) to disable the sounder. An alarm reset light shall be provided on the operator panel.

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3.4 TEMPERATURE SHUTDOWN

There shall be provision for accepting in the AC Power Panel #4 a normally open thermal shutdown input from the power supply. This input shall be monitored at all times and a closed circuit shall result in the memory system being shutdown.

A thermal shutdown will be accomplished by closing a normally open contact circuit in the power system. This circuit closure will be tied to the AC Power Panel #4 overtemperature (Level 2) shutdown circuit.

3.5 REMOTE VOLTAGE MARGINS

The memory power supply system will have remote control of the voltage margin switching functions as follows:

3.5.1 Voltage Margin Function

<u>Bit 1</u>	<u>Bit 2</u>	<u>Voltage State</u>
0	0	Normal
0	1	+5 Percent
1	0	-5 Percent
1	1	Illegal Condition

Logic "0" is approximately zero volts.
Logic "1" is approximately +5 volts.

3.5.2 Voltages to be Margin Switched (2 Lines per Voltage)

<u>Margin Data Bit</u>	<u>P00 Pin Number (CC)</u>	<u>Function</u>	<u>Bit</u>
		+ High Voltage	1
		+ High Voltage	2
		- High Voltage	1
		- High Voltage	2
		+5 volts	1
		+5 volts	2

Even pins 02-28 are all d-c return pins in P00.

3.5.3 Conditions

Each core controller controlled voltage shall be capable of being independently controlled from normal to +5 percent or -5 percent from core controller inputs.

3.6 OTHER CONTROL CIRCUITS

3.6.1 Metering

There shall be an ammeter and a voltmeter provided for monitoring of current and voltage for each of the following supply outputs:

Low VoltageHigh Voltage

+5 volt - core controller

+15 volts

+5 volts - magnetics module

-15 volts

Each independent output shall be monitored.

3.6.2 Power Disconnect Switches

Provision shall be made for removing all d-c power (and fan power) to either cabinet of the BCSU to facilitate maintenance on magnetics modules. The system may be turned off when opening or closing the power switches.

3.7 REMOTE SENSING

Provision shall be made for remote sensing of +5 volts to each CSM.

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4. REGULATED POWER OUTPUT REQUIREMENTS4.1 OUTPUT VOLTAGES AND LOADS4.1.1 Regulator Requirements - Low Voltage

	<u>1st Cabinet</u>		<u>2nd Cabinet</u>
	<u>+5V</u>	<u>+5V</u>	<u>+5V</u>
	#1 & #2	CC	#1 & #2
Output Voltage Normal	+5V	+5V	+5V
Output Current Design Minimum	56A/52A	40A	56A/52A
Adjustment Range (Minimum)	<u>+5%</u>	<u>+5%</u>	<u>+5%</u>
Margin Percent Of Set Value	<u>+5%</u>	<u>+5%</u>	<u>+5%</u>
D-C Load Regulation 0 to 100 Percent Load	<u>+1%</u>	<u>+1%</u>	<u>+1%</u>
Total Tolerance 1000 hours, Load Regulation, Temperature, Line & Load Variations	<u>+2%</u>	<u>+2%</u>	<u>+2%</u>
Transients Load Step Change	<u>+5%**</u>	<u>+5%</u>	<u>+5%**</u>
Ripple*	50mv _{pp}	50mv _{pp}	50mv _{pp}
Spikes on Ripple*	300mv _p	300mv _p	300mv _p

*At constant rated current

**Transient 10 amp step change.

4.1.2 Regulator Requirements - High Voltage (Both Cabinets)

	<u>Cabinet #1&2</u> <u>+High Voltage</u> Per CSM	<u>Cabinet #1&2</u> <u>-High Voltage</u> Per CSM
Output Voltage Nominal	15	-15
Output Current Design Minimum	36/16	5/3
Adjustment Range Minimum	15-25V	15-25V
Margin Percent of Set Value	$\pm 5\%$	$\pm 5\%$
D-C Load Regulation 0 to 100 Percent Load	$\pm 1\%$	$\pm 1\%$
Total Tolerance 1000 hours, Load Regulation, Temperature, Line & Load Variations	$\pm 2\%$	$\pm 2\%$
Transients 50% Load to Full Load Step Change	$\pm 5\%$	$\pm 5\%$
Ripple*	250mv _{pp}	250mv _{pp}
Spikes on Ripple*	300mv _p	300mv _p

*At constant rated current

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4.2 OVERVOLTAGE PROTECTION

4.2.1 Overvoltage Warning and Shutdown

<u>Voltage</u>	<u>Core Controller Warning</u>	<u>Maximum Shutdown Voltage</u>
+5V Core Controller	Yes	+6.5V
+5V	Yes	+6.5V
+ High Voltage	Yes	+27.0V
- High Voltage	Yes	-27.0V
The warning is a lack of the confidence signal (+10 percent of nominal).		

4.3 UNDERVOLTAGE PROTECTION

4.3.1 Undervoltage Warning and Shutdown

<u>Voltage</u>	<u>Core Controller Warning</u>	<u>Minimum Shutdown Voltage</u>
+5V Core Controller	Yes	+4.2V
+5V	Yes	+4.2V
+ High Voltage	Yes	+12V
- High Voltage	Yes	-12V
The warning is the lack of a confidence signal (-10 percent of nominal).		

4.4 OVERCURRENT PROTECTION

All output voltage supplies shall have over-current protection as follows:

Each supply shall be essentially constant voltage from 0 percent load to 100 percent load. At approximately 110 to 150 percent of rated load the supply shall limit on current and fail on under-voltage, or equivalent action.

4.5 MARGINS

Each voltage that has margins per Section 4.1.1 and 4.1.2 will have provision for local margin switching located in the power supply as follows, per regulator.

+5 Percent ± 0.5 Percent
Normal
-5 Percent ± 0.5 Percent

Local margin switching shall take precedence over remote voltage margin controls.

5. ENVIRONMENT

The environment requirements are the same as 43A177851.

6. MAINTAINABILITY

6.1 GENERAL

The elements of the power system shall be designed to facilitate maintenance and ease of access to terminal boards, printed wiring boards, adjustments and controls.

6.2 MEAN TIME BETWEEN FAILURE

The design goal MTBF for each regulator output voltage shall be 200,000 hours or greater.

The BCSU power system design goal MTBF shall be 25,000 hours or or greater in 1972.

6.3 EQUIPMENT LIFE

The equipment shall have a normal service life of not less than 10 years, with only normal maintenance performed at the computer installation.

6.4 MEAN TIME TO REPAIR

A design goal for 1972 is 0.5 hours mean time to repair with 95% of the repairs being completed in 2.8 hours or less.

7. PHYSICAL SIZE

The power supply subsystem shall be compatible with the Series 6000 system frame and chassis space allocation per drawing 43D232442.

8. PREREQUISITES

Prerequisites are the applicable document, Section 1.2 of this document and EPS 43A177851.

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